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Sponge invaders in Dutch coastal waters

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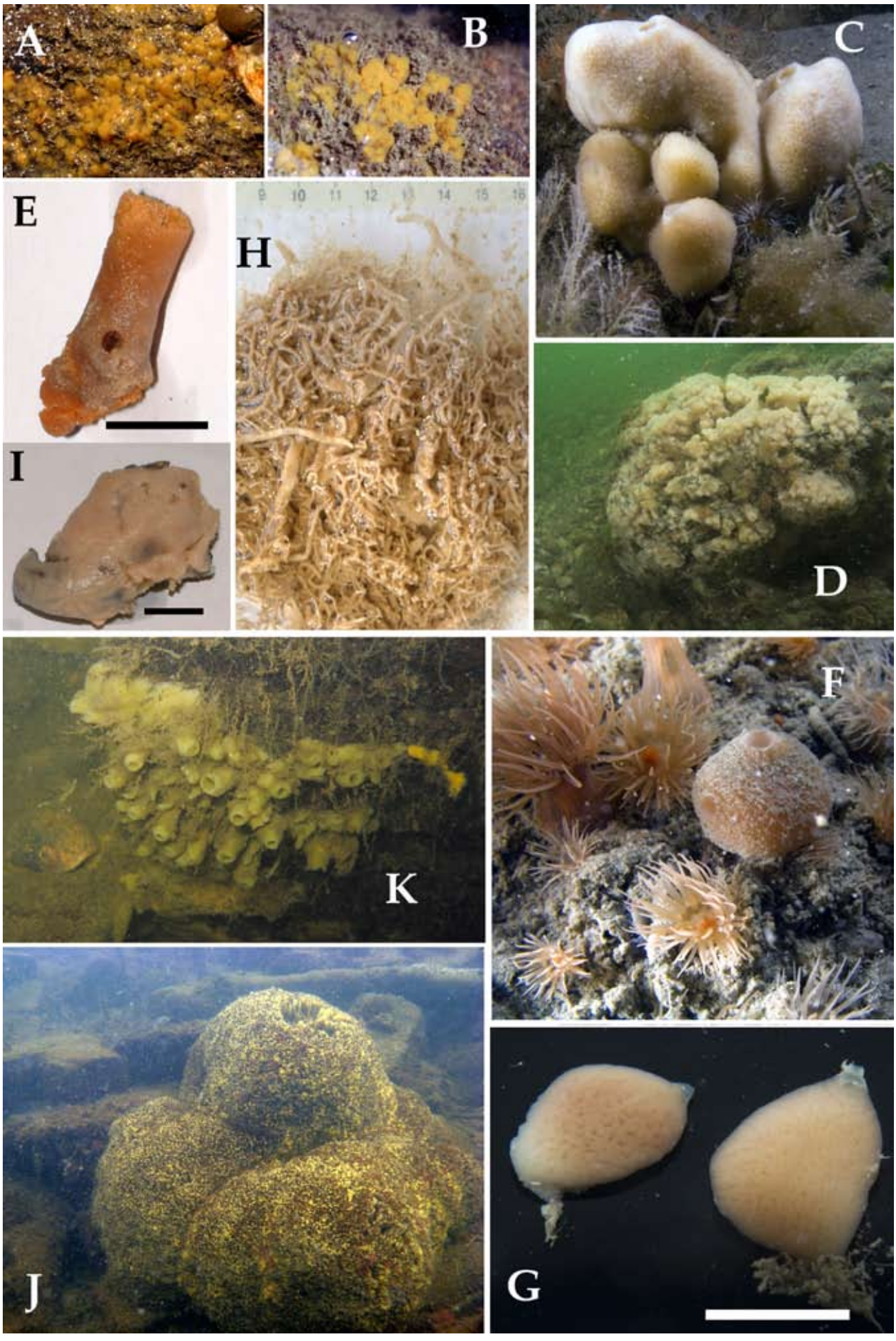
Continuous monitoring by scientists and volunteers of the Biological Working Group of the Dutch SubAqua Union and the 'Anemoon' Foundation over the past four years, yielded a surprising six new records of sponges for Dutch coastal waters. *Oscarella lobularis*, *Celtodoryx girardae*, *Suberites virgultosus*, *Haliclona* (*Haliclona*) *simulans*, *Halisarca* aff. *dujardini*, and a species identified as *Leucosolenia somesii* were unknown from Dutch coastal waters before 2000. The latter is a giant calcareous sponge, seemingly belonging to the common *Leucosolenia variabilis*, but here assumed to be an invader as well, as it has spicular characters well outside the variation found in the majority of Dutch *L. variabilis* specimens. It is likely a member of a 'forgotten' species, *L. somesii*. Habit photographs, SEM images of the spicules, and for *O. lobularis* and *H.* aff. *dujardini*, photographs of histological sections are provided to substantiate these new records. With the exception of *C. girardae*, most of the species resemble previously described widespread north-east Atlantic species, occurring in the area to the south and west of the Netherlands, so it is assumed pending future genetic research that at least several of the invaders comprise range extensions related to rising winter temperatures. Possibly, recent shellfish imports may be an additional causal agent. We also report the occurrence of unprecedented spicular deviations observed in three sponge species commonly occurring in Dutch waters, *Halichondria* (*Halichondria*) *panicea*, *Hymeniacidon perlevis* and *Haliclona* (*Soestella*) *xena*, which grew in small inland water bodies. Possibly, the limited space in these inland waters with possible stress factors for sponges such as reduced water exchange, and deviating chemistry, have caused the sponges to form stunted growth in spicules varying from rhabds with rounded endings to silica spheroids. We provide an updated list of sponges found in Dutch waters and a list of suspected or proven invaders of Dutch waters.

INTRODUCTION

Invasive marine species have increasingly impacted the Dutch inshore and coastal waters over the past decades. The prime example is the Japanese oyster *Crassostraea gigas* (Thunberg), which has colonized all available hard substrates in the waters of the south-western Netherlands and continues to expand in the Wadden Sea (Drinkwaard, 1999; Wolff, 2005). Along with it, or possibly independent of it, many algae, among which several spectacular species such as *Sargassum muticum* Fensholt and *Undaria pinnatifida* (Harvey), and (in)vertebrates as annelids, bivalves, gastropods, crabs, tunicates, bryozoans and fish new for the Dutch fauna have settled in our waters (Reise et al., 1999; Wolff, 2005). Although the oyster *Crassostraea gigas* was introduced on purpose for commercial reasons, the unwanted simultaneous introduction along with the oyster of these other organisms remains unproven. Nevertheless the coinciding introductions of these exotic organisms support the suspicion that most if not all were carried by imported oyster sprat. It is likely that the success of *Crassostraea gigas* following its introduction in the south-western Netherlands is correlated with climatic changes since 1975. Moderate winter temperatures in several consecutive years have enabled the species to reproduce contrary to expectations of those who took the decision to have it introduced. Possibly, some of the other invaders likewise profited from benign climatic circumstances.

Sponges of the Netherlands were the subject of a number of scientific studies in the recent past: van Soest (1977) reporting 15 marine species; Buizer & van Soest (1977) reassigning a previously reported species to a species new to science. This was later on done also for a species previously identified as *Prosuberites epiphytum* (Lamarck, 1814), which was found to be an obligate Australian epiphyte of algae. The Dutch and other European representatives were assigned to a species new to science, *Protosuberites denhartogi*, by van Soest & de Kluijver, 2003. Although the reviews of introductions in the North Sea (Reise et al., 1999) ignored sponges of the Netherlands or gave inaccurate or outdated information on sponges, they had their share in episodes of faunal invasions. *Sycon scaldiense* (van Koolwijk, 1982), an apparently invasive species new to science and of unknown origin, was first recorded in 1975 and is so far only known from the Oosterschelde area. *Haliclona* (*Soestella*) *xena* de Weerdt, 1986, with first records in 1977, has become one of the more common species in the waters of the Netherlands,



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Belgium, north-western France (Breton et al., 1996) and Helgoland (since 2004, M.J. de Kluijver, personal observation). De Weerdt (1986) added range extensions of two *Haliclona* species from neighbouring European countries into Dutch waters: (*H.* (*Reniera*) *cinerea* (Grant, 1826); and *H.* (*Rhizoniera*) *rosea* (Bowerbank, 1866)). A new invader appeared in 1989: *Suberites massa* (Lieberkühn, 1859), first observed in the Oosterschelde near the location Zeelandbrug at 4.8 m depth with a field photograph and a microscopic slide (made by M.J. de Kluijver) and reported in van Soest et al. (2000). Subsequently, the species was observed again in 2005 (ZMA Por. 16240, Netherlands, Zeeland, Oosterschelde, near Zierikzee, 50 m west of Zeelandbrug, depth 4 m, 24 October 1999, 51.64°N 3.91°E, coll. A. Gittenberger, on a big stone). In 2006 this species had extended its local range. It is a common species throughout the entire southern Oosterschelde region; it is locally present in the north-eastern region but has not been found in the central-north and north-western region of the Oosterschelde. A Dutch-language survey of the sponges of the province of Zeeland (van Soest, 2005) provided an updated Dutch sponge fauna comprising 18 species of which three were not considered autochthonous, as these were represented only by unattached beached forms.

The faunal invasions are ongoing, and are possibly enhanced, as each year new records of plant and animal groups are published. Sponges are no exception: below we will provide the descriptions of an unprecedented six sponges new to the Dutch inshore fauna since these earlier reports. We will refrain from erecting new species or subspecies for these new records, but several of them, though closely similar to species occurring in neighbouring north-east Atlantic areas, appear subtly different and may need to be investigated further by genetic techniques in order to test their conspecificity with north-east Atlantic species.

We also take this opportunity to record specimens of three species of sponges already known from Dutch waters but distinguished by deviating growth form and spicular characteristics. At this stage, we do not suppose that these deviating individuals comprise invaders, because they occurred in small inland water bodies with limited connections to surrounding marine basins.

MATERIALS AND METHODS

Specimens were photographed *in situ* and subsequently a subset of the observed individuals was preserved in 96% ethanol. In the case of *Oscarella lobularis* and *Halisarca dujardini*, several individuals were first fixed in 4% formalin for 24 h and subsequently preserved in ethanol. All preserved material is incorporated in the collections of the Zoological Museum of Amsterdam (ZMA) and the National Museum of Natural History Naturalis (RMNH).

Sponges were identified by examination of thick sections and dissociated spicules (van Soest et al., 2000 for a description of methods). The dissociated spicules were mounted on microscope slides in Canada balsam for light microscopy, as well as put on stubs, coated in gold for SEM microscopy. In the case of *Oscarella lobularis* and *Halisarca dujardini*, microtome sections (12/16/20 μm) were prepared for histological treatment using Mallory Cason stain and after dehydration mounted in Euparal.

For comparison, specimens of adjacent north-east Atlantic areas present in the collections of the ZMA were studied. Descriptions provided by van Soest et al. (2000) were taken as a basis for the identifications.

SPECIES NEWLY RECORDED FROM DUTCH INSHORE WATERS

The order in which the species are presented follows Hooper & van Soest (2002).

Phylum Porifera
Class Demospongiae
Order Homosclerophorida
Family Plakinidae
Oscarella lobularis (Schmidt, 1862)
Figures 1A,B & 2A

Material examined

ZMA Por. 19117, Netherlands, Zeeland, Neeltje Jans, near pier head of the outer harbour, depth not recorded, 51.621°N 3.667°E, 01 April 2006, coll. M. Faasse, colour light brown. RMNH Por. 2925, Netherlands, Zeeland, Neeltje Jans, near south pier head of outer harbour, depth not recorded, 51.621°N 3.667°E, 15 July 2006, coll. M. Faasse, colour light brown.

Studied for comparison: ZMA Por. 09637, France, Bretagne, Roscoff, Chenal d'Île Verte, intertidal, 48.735°N 3.986W, 28 September 1966, coll. J.H. Stock, colour reddish. ZMA Por. 10888, Ireland, Kerry, Cahirsiveen, White Strand, under stones at low water mark, coordinates 51.94333°N 10.275W, 25 June 1994, coll. R.W.M. van Soest, colour light brown.

Description

Shape, size, surface, colour and consistency: thin sponge with a lateral expansion of several cm (Figure 1A,B). Surface covered with characteristic small lobules, with small oscules on their apices; surface otherwise smooth; colour light brown. Consistency softly gelatinous.

Microscopical observations: no spicules. Choanocytes arranged in large rounded 'eurypylous' chambers 35–90 μm, positioned along the excurrent canals (Figure 2A).

Figure 1. Habits of specimens discussed in the text: (A,B) *Oscarella lobularis* (*in situ*, photograph: M. Faasse); (C) *Suberites virgultosus* (*in situ*, photograph: P. van Bragt); (D) *Celtodoryx girardae* (*in situ*, photograph: R. Doornberg); (E) *Haliclona* (*Haliclona*) *simulans* (preserved fragment); (F,G) *Halisarca* aff. *dujardini* (*in situ* (F) and preserved (G) (photographs: P. van Bragt); (H) *Leucosolenia* aff. *somesii* (preserved); (I) *Hymeniacidon perlevis* from Veerse Meer (preserved); (J) *Halichondria* (*Halichondria*) *panicea* (?) from Schelphoekplas (*in situ*, photograph: R. Nijland); (K) *Haliclona* (*Soestella*) *xena* from Schelphoekplas (*in situ*, photograph: R. Nijland). Scale bars: A–C, E–G, I, 1 cm; D,J,K, 10 cm.

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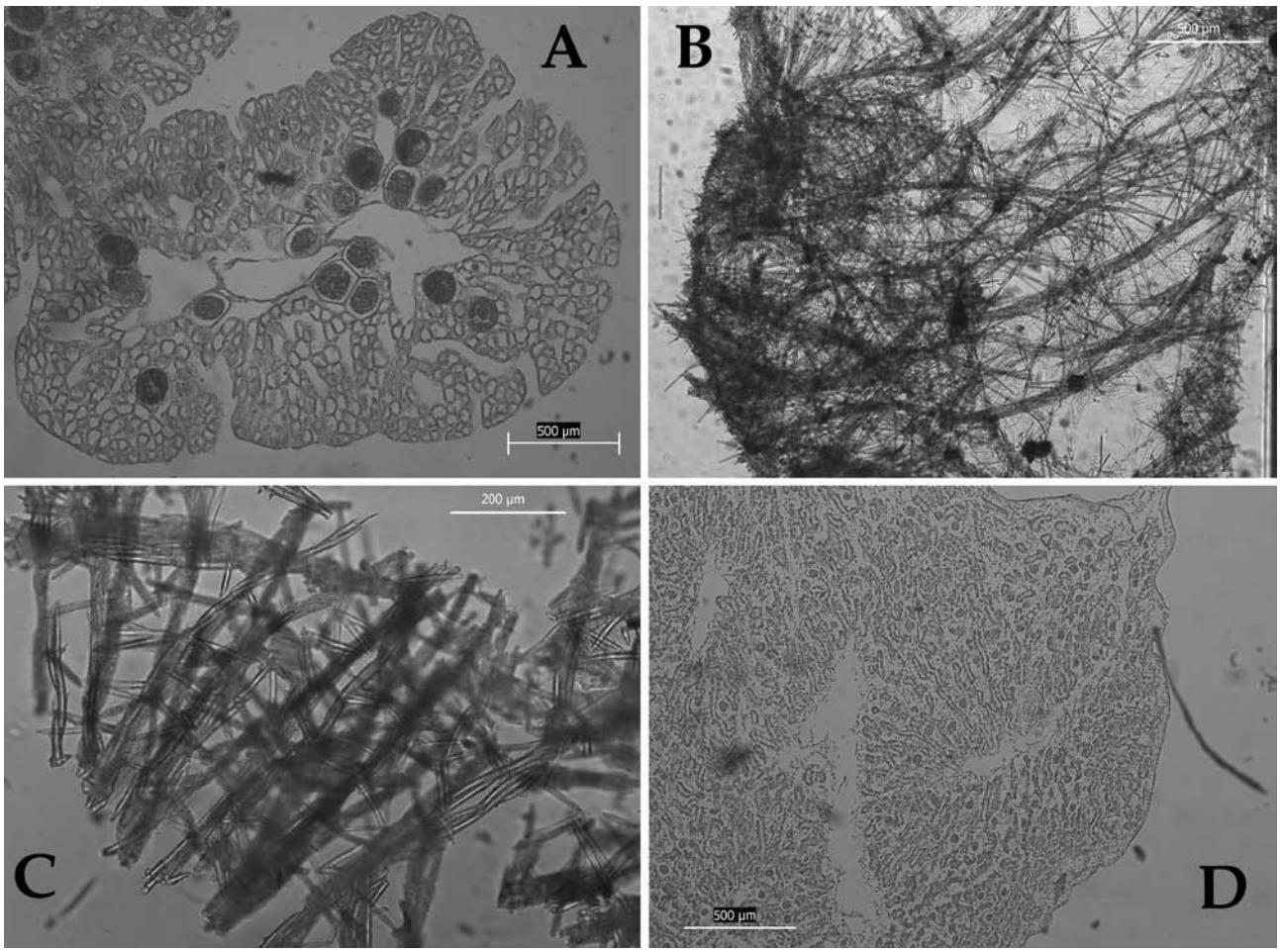

Figure 2. Light microscopy images of specimens described in the text: (A) *Oscarella lobularis* (histological section); (B) *Celtodoryx girardae* (hand section of skeleton); (C) *Haliclona* (*Haliclona*) *simulans* (hand section of skeleton); (D) *Halisarca* aff. *dujardini* (histological section).

Remarks

No obvious differences other than colour are apparent between the Dutch specimens and other European specimens. Recorded for the first time in the Netherlands in April 2006 and subsequently collected again in the same locality in July of the same year. It is too early to speculate upon mode of introduction and likelihood of continued establishment in the Netherlands. The locality (seaward side of the south-western entrance of the Oosterschelde) suggests a possible natural range extension, rather than import by shellfish.

Order Hadromerida
Family Suberitidae
Suberites virgultosus (Johnston, 1842)
Figures 1C & 3A

Material examined

ZMA Por. 18970, Netherlands, Zeeland, Oosterschelde, Westbout, Burgsluis, depth approximately 12 m, 51.68°N 3.76°E, 23 July 2005, coll. P.H. van Bragt, pinkish pale brown. ZMA Por. 18971, Netherlands, Zeeland, Oosterschelde, Roompot, Wissekerke, depth approximately 8m, 51.63°N 3.72°E, 24 July 2005, coll. P.H. van Bragt, pinkish pale brown. ZMA Por. 18973, Netherlands, Zeeland, Oosterschelde, Westbout, Burgsluis, depth approximately 8 m, 51.68°N 3.76°E, 19 June 2005, coll. P.H. van Bragt, pinkish pale brown.

Studied for comparison: ZMA Por. 16221, Great Britain, off Yorkshire, Doggerbank, depth not recorded, 54.83°N 1.17°E, 03 September 1999, coll. H. Ranner.

Description

Shape, size, surface, colour and consistency: smallish, approximately 5 cm upright, wedge-shaped sponges with terminal small oscule (Figure 1C). Individuals may coalesce, to form laterally compressed, lobate sponges. Oscules with small transparent collar. Surface velvety, slightly granular, but optically smooth. Colour pinkish pale brown. Consistency firm.

Skeleton: ectosomal skeleton consists of brushes or bouquets of small tylostyles, points outwards, with microscleres concentrated in the interstices between the brushes. Choanosomal skeleton: confusedly reticulate, alveolar, made up of larger tylostyles.

Spicules (Figure 3A): megascleres tylostyles in two non-overlapping size-categories, heads usually terminal and tyles distinctly developed, occasionally double-layered, 255–316.8–376 × 2–6.2–10 µm and 108–133.3–164 × 2–3.6–5 µm. Microscleres curved or straight, entirely spined centrotylote microrhabds, possibly divisible in a longer slim curved type and a shorter thick straight type, 18–36 × 0.5–2.5 µm (centrotyle up to 4 µm).

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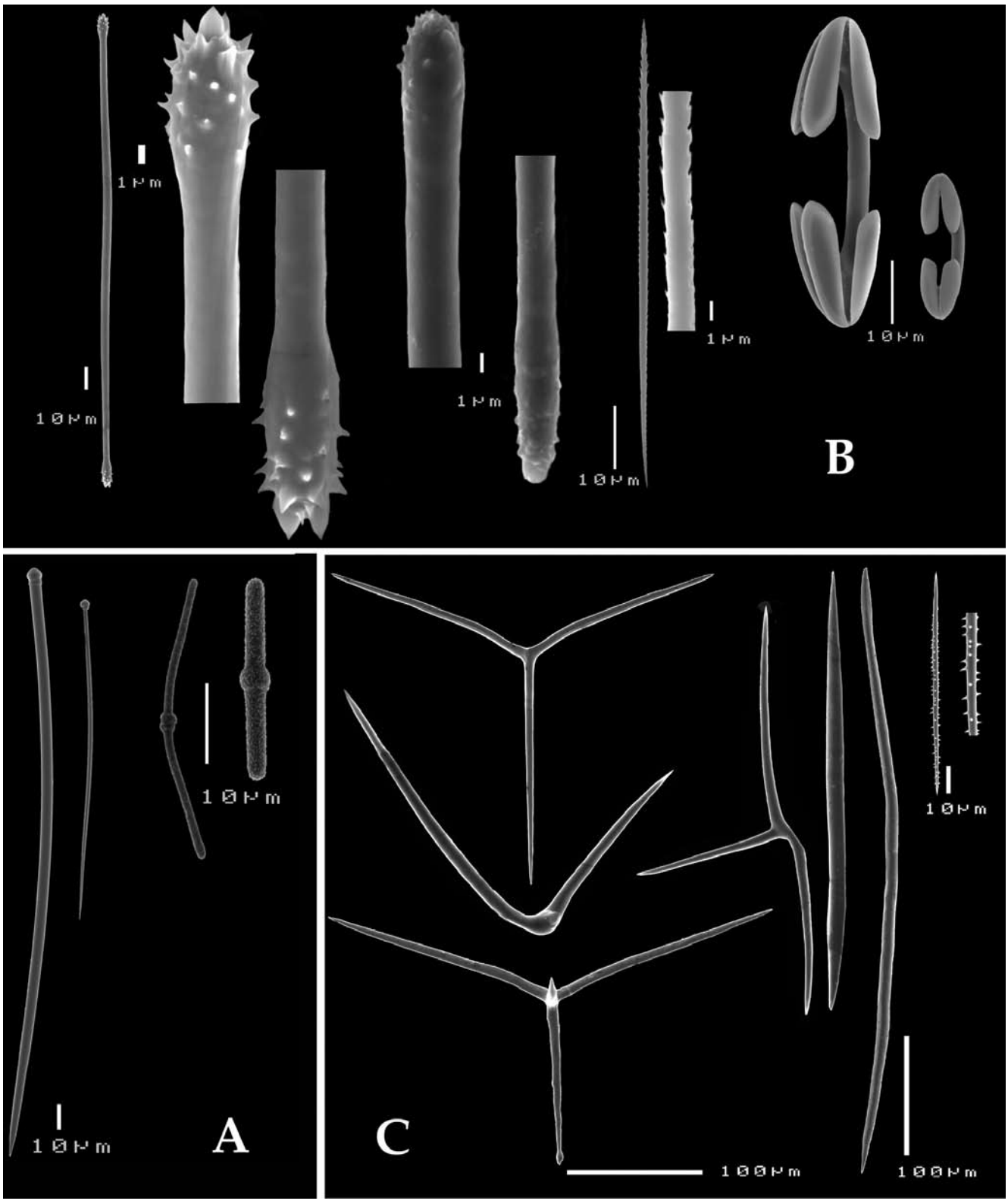

Figure 3. Scanning electron microscopy images of spicules of specimens discussed in the text: (A) *Suberites virgultosus;* (B) *Celtodoryx girardae;* (C) *Leucosolenia* aff. *somesii*, ZMA Por. 17572.

Remarks

The present specimens are here hesitatingly attributed to *Suberites virgultosus*, commonly known from the Doggerbank area opposite the coast of Yorkshire, but also from elsewhere in the southern North Sea. There are a few discrepancies with the North Sea specimens (see van Soest et al., 2000) as these grow to several dm high and invariably are attached to living or dead gastropods or scaphopods in course sands, whereas the Zeeland material is much smaller and is attached to rubble in a muddy environment. The surface skeleton of these offshore specimens also has a much denser layer of centrotylote microscleres than was observed in the inshore specimens. However, spicule sizes and shapes, including the characteristic 'ficulina' microscleres are similar to the

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Zeeland specimens and the small apical oscule combined with the wedge-shaped habit appears close enough to consider the two forms conspecific. The diversity of shapes of microscleres could be a potential discriminatory character, but this needs further study. The species shares its 'ficulina' microscleres with *Suberites ficus* (Johnston, 1842), reported from the Netherlands part of the North Sea (van Soest, 1977), but this species differs in being much more massive and having much larger oscules. In fact all but one of the specimens reported as *Ficulina ficus* in van Soest (1977) belong to *Suberites virgultosus*, so the finding of the present specimens represents only a small range extension into Dutch inshore waters. The microscleres are also shared with and similar to those of *Suberites suberia* (Montagu, 1818) occurring likewise on offshore North Sea locations (van Soest et al., 2000), but this species is always inhabited by a hermit crab.

Order Poecilosclerida
Suborder Myxillina
Family Coelosphaeridae
Celtodoryx girardae Perez, Perrin, Carteron, Vacelet & Boury-Esnault, 2006
Figures 1D, 2B & 3B

Material examined

ZMA Por. 19826, Netherlands, Oosterschelde, Wemeldinge, 2.5 m, coll. M.J. de Kluijver, no. 1430, 22 August 2005; ZMA Por. 19808, Netherlands, Oosterschelde, Wemeldinge, 7.2 m, coll. M.J. de Kluijver, no. 1477, 11 July 2006.

Description

Shape, size, surface, colour and consistency (based on two specimens and photographs and field observations): globular-massive, cauliflower-like, with irregularly lobate to honeycombed surface, occasionally with tube-like semi-transparent extensions (Figure 1D). Preserved material up to 10 cm diameter cut off from specimens up to 30 cm diameter. However, size may be considerably greater, as specimens covering an area of up to 25 m^2 are reported off the island of Tholen in the eastern region of the Oosterschelde. Colour pale yellow, or pale brown, not unlike certain forms of *Halichondria panicea*. Consistency soft, easily damaged.

Skeleton: ectosomal skeleton a loose tangential arrangement of single tylote/strongylote megascleres and numerous microscleres. Choanosomal skeleton (Figure 2B) plumose or plumoreticulate, reminiscent of *Tedania*; megascleres form bundles of 40–150 μm in diameter fanning out towards the surface and forming a loosely connected reticulation.

Spicules (Figure 3B): (1) megascleres at first glance of a single type, tylotes, but they are quite variable in thickness and ornamentation. Possibly they consist of two types, one derived from proper tylotes (thinner, shorter), 193–259.0–320 × 2–3.6–5 μm, the other from styles (thicker, longer), 294–351.7–384 × 6–8.3–10 μm, but these types do not appear to be localized; (2) oxychaetes, symmetrical finely spined microscleres, ends tapering to thin points, 69–76.3–81 × 0.5 μm; and (3) arcuate chelae in two distinct size categories, 23–24.2–25 μm and 52–57.1–63 μm.

Remarks

This genus and species was recently erected (Perez et al., 2006) for specimens recorded from the south of Bretagne (France), in a well studied area from where it was previously unknown. It is likely an invader from an unknown part of the world.

Very shortly afterwards, or perhaps more or less simultaneously, the species was found to occur in the Netherlands, either imported from France or from the same unknown source area. The species appears to be well established as specimens were collected in consecutive years and it is reported to have developed very large individuals in several Oosterschelde localities (P. v. B., personal observation).

Order Haplosclerida
Suborder Haplosclerina
Family Chalinidae
Haliclona (*Haliclona*) *simulans* (Johnston, 1842)
Figures 1E & 2C

Material examined

ZMA Por. 17007, Netherlands, Zeeland, Lake Grevelingen, Scharendijke, depth 7.5 m, 51.75°N 3.86°E, 09 July 2001, coll. M.J. de Kluijver, colour red-brown.

Studied for comparison: ZMA Por. 16513, France, Bretagne, Roscoff, Ar Tourtu, depth 25 m, 48.688°N 3.884°W, July 1992, coll. M.J. de Kluijver, colour red-brown. Shape, surface and consistency: the specimen is a fragment of rounded branch, 2.5 cm long, 0.8 cm diameter, cut off from a long branch of 10+ cm long (Figure 1E). Surface smooth, provided with two slighty raised oscules. Consistency stiff, fragile. Colour red-brown.

Skeleton: a strongly developed ladder-like reticulation (Figure 2C) with tracts containing 2–5 spicules, with nodal spongin, occasionally enveloping entire stretches of tracts. Ectosomal skeleton a tangential, regular, triangular reticulation.

Spicules: exclusively oxeas of uniform shape and size: 131–141.9–156 × 8–9.9–13 μm.

Remarks

This is a distinct species, which cannot be easily confused with other European *Haliclona* species. The spicules and skeleton of our fragment conforms closely with de Weerdt's (1986) revision of the species. The common *Haliclona* (*Haliclona*) *oculata* is likewise branched, but much softer and lacks the tangential surface skeleton. *Haliclona* (*Reniera*) *cinerea* reported occasionally from Dutch waters (ZMA 03145, 04470 and 18977) may develop irregular branches but these are thinner and much softer, while the reticulation is strictly unispicular. Spicules of both are significantly shorter and thinner. *Haliclona* (*H.*) *simulans* is common elsewhere along the western coasts of France and the British Isles (de Weerdt, 1986), and thus its occurrence in Dutch waters represents a slight north-eastward extension of the known distribution.

Order Halisarcida
Family Halisarcidae
Halisarca aff. *dujardini* Johnston, 1842
Figures 1F,G & 2D

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Material examined

ZMA Por. 19067, Netherlands, Zeeland, Oosterschelde, Roompot Binnen, depth approximately 9 m, 51.617°N 3.695°E, July 2005, coll. P.H. van Bragt, colour pink-brown. ZMA Por. 19127, Netherlands, Zeeland, Oosterschelde, Roompot Binnen, depth 12 m, 51.617°N 3.695°E, 14 May 2006, coll. P.H. van Bragt, colour pink-brown.

Studied for comparison: ZMA Por. 04390, Ireland, Cork, Sherkin Island, Hake Island, intertidal, 51.48°N 9.415°W, 16 August 1978, coll. R.W.M. van Soest, greyish brown; ZMA Por. 10159, Ireland, Kerry, Cahirsiveen, White Strand, intertidal, 51.94333°N 10.275°W, 16 May 1992, coll. R.W.M. van Soest, greyish-brown; ZMA Por. 17874, Ireland, Kerry, Cahirsiveen, White Strand, intertidal, 51.94333°N 10.275°W, 01 September 1998, coll. R.W.M. van Soest, greyish-brown; ZMA Por. B2006/BX03, Great Britain, Scotland, Outer Hebrides, off Mingulay, depth 173 m, 56.82738°N 7.39597°W, 09 July 2006, coll. R.W.M. van Soest, colour beige.

Description

Shape, size, surface, colour and consistency: predominantly globular individuals, usually less than 1 cm diameter, with one or occasionally two oscules, approximately 1–2 mm in diameter, with raised rims (Figure 1F,G). Some individuals are anastomosed to form lobate masses, approximately 1 cm high and wide, and several cm long. All observed specimens were growing on residual hydroid stalks. Surface membrane semitransparent, providing views of a punctate, somewhat granular, inner tissue. Surface smooth. Colour of inside tissue pink. Consistency extremely soft, specimens disintegrating easily in preservation.

Choanosome (Figure 2D): reconstructed from two-dimensional histological sections, the choanocyte chambers are branched or lobed, usually only with bifid or trifid shapes, occasionally unbranched elongate shapes occur. Length of choanocyte chambers 175–227.6–330 × 30–70.0–100 (N= 10), individual lobes 60–100 μm. Aquiferous channels up to 200 μm wide.

Remarks

The persistent globular shape is a striking feature of the Dutch specimens, as the specimens from Ireland were flat incrustations (see also van Soest et al., 2000). However, a deep-water specimen from Scotland collected recently, appeared very similar in shape to the Dutch specimens. In the absence of clear differences, we assign the new Dutch records to *Halisarca dujardini*.

Class Calcarea
Subclass Calcaronea
Order Leucosolenida
Family Leucosoleniidae
Leucosolenia aff. *somesii* (Bowerbank, 1874)
Figures 1H, 3C & 4A,B

?*Leuconia somesii* Bowerbank, 1874: 334, pl. XCI figures 6–17.

Material examined

ZMA Por. 17572, Netherlands, Zeeland, Colijnsplaat, in incurrent tube of a running seawater system, November 2002, 51.60193°N 3.85012°E, coll. M. Dubbeldam, colour white. ZMA Por. 11389, Netherlands, Neeltje Jans, Roompot-Buiten, northern shore of south pier, near lock, 04 June 1996, 51.63°N 3.72°E, LLWS, coll. R.W.M. van Soest.

Studied for comparison: *Leuconia somesii*, lectotype BMNH 1925.11.2.24 and paralectotype BMNH 1925.11.2.25, Bowerbank collection, Bristol Aquarium; slides of the same: BMNH 1956.4.26.35, 37 *Leucosolenia variabilis*: ZMA Por. 00167, Netherlands, Noord-Holland, Den Helder, Helderse Buitenhaven, 52.9667°N 4.6667°E, depth 6 m, 27 June 1950, coll. J.H. Stock. ZMA Por. 00169, Netherlands, Noord-Holland, Nieuwe Diep, 52.9667°N 4.7833°E, coll. W.S.S. van Benthem Jutting, no further data. ZMA Por. 03111, Netherlands, Zuid-Holland, Huisduinen, 52.95°N 4.7333°E, 24 September 1951, coll. C. Swennen. ZMA Por. 03088, Netherlands, Zeeland, Strijenham, 51.52°N 4.16°E, depth 5–6 m, 18 October 1964, coll. G. Kleeton. ZMA Por. 03095, Netherlands, Zeeland, Yerseke, Oosterschelde, 51.49°N 4.06°E, 01 September 1951, coll. J.H. Stock. ZMA Por. 03119, Netherlands, Zeeland, east of Yerseke 'Het Zuiden', oesterput van Cornelissen, 51.48°N 4.06°E, 04 September 1951, coll. J.H. Stock. ZMA Por. 03102, Netherlands, Zeeland, Wemeldinge, Kanaal door Zuid-Beveland, western pile of Postbrug, 51.5°N 4.02°E, 29 August 1950, coll. J.H. Stock. ZMA Por. 04089, Netherlands, Zeeland, Wemeldinge, Oosterschelde, west sluis, 51.52°N 4.02°E, 17 August 1976, coll. S. Weinberg. ZMA Por. 04233, Netherlands, Zeeland, Wemeldinge, Oosterschelde, on pontoon Rijkswaterstaat, 51.52°N 4.02°E, 06 May 1977, coll. R.W.M. van Soest, D.A.G. Buizer & J.J. Vermeulen. ZMA Por. 04181, Netherlands, Zeeland, Zierikzee, 51.65°N 3.92°E, 03 August 1976, coll. R.W.M. van Soest and J.J. Vermeulen. ZMA Por. 04191, Netherlands, Zeeland, Schouwen Duiveland, werkhaven Schelphoek, 51.7°N 3.82°E, 07 April 1977, coll. D.A.G. Buizer and J.J. Vermeulen. ZMA Por. 04197, Netherlands, Zeeland, Zierikzee, , 51.65°N 3.92°E, 03 August 1976, coll. R.W.M. van Soest and J.J. Vermeulen. ZMA Por. 04711, Netherlands, Zeeland, Grevelingen, Dreischor, 5.17°N 3.86°E, depth 6 m, 10 August 1981, coll. K. ter Kuile. ZMA Por. 17932, Belgium, West Vlaanderen, Zeebrugge Harbour, 51.32°N 3.18°E, 22 April 2004, coll. H. de Blauwe. ZMA Por. 02703, France, Pas de Calais, Wimereux, 50.7667°N 1.6167°E, 10 July 1967, coll. J.H. Stock. ZMA Por. 09689, France, Pas de Calais, Audresselles, 50.8167°N 1.5833°E, 07 July 1951, coll. Excursion Ambleteuse 1951. ZMA Por. 09708, France, Pas de Calais, Ambleteuse, Langue-de-chien, 50.817°N 1.58°E, 11 July 1951, coll. Excursion Ambleteuse 1951. ZMA Por. 05218, Spain, Galicia, Isla La Toja, in sea grass meadow, 42.484°N 8.845°W, 19 August 1983, coll. R. Ates. ZMA Por. 10889, Ireland, Kerry, Cahirsiveen, White Strand, 51.9433°N 10.275°W, 25 June 1994, coll. R.W.M. van Soest. ZMA Por. 16318, Ireland, Cork, Sherkin Island, Crab Rock, 51.458°N 9.44°W, depth 9 m, 07 August 1981, coll. M.J. Leloup and M. Reichert. ZMA Por. 17867, Germany, Helgoland, Südhafen, on pontoon, 54.1771°N 7.894047°E, 2004, coll. M.J. de Kluijver. ZMA Por. 00171, Norway, no further location, coll. M. Weber, det. E. Arnesen. ZMA Por. 04974, Norway, Bergen, Hjeltefjorden, Björgvin, 60.24052°N 5.233656°E, depth 25 m, 22 August 1982, coll. R.W.M. van Soest.

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Table 1. *Habit size and spicule characteristics of* Leucosolenia somesii *(Bowerbank, 1866) and* Leucosolenia variabilis *(Haeckel, 1870) specimens from the Netherlands and adjacent countries in Europe. Spicule size data in micrometres, based on 25 measurements per specimen for each spicule type; average sizes printed italic. In case of less than 25 measurements, only the range is provided.*

ZMA reg. no.	Locality	Size (cm)	Large oxea	Intermediate oxea	Spined microxea	Triact paired rays	Triact unpaired ray	Tetract paired rays	Tetract apical ray	T–shaped	Malformed T/V
L. somesii											
17572	Colijnsplaat	12×12×8	450–*533*–600	240–*302.5*–360	96	23–*144.0*–188	103–*123*–155	140–155	20–32	58–*72.4*–102	140
			8–*8.5*–10	?	1–*1.5*–2	2–*4.6*–7		4–*4.5*–5	2–*3.1*–4	4–*5.6*–9	7
11389	Roompot–Buiten	2–3	470–561.7–672	165–247.4–300	81–*89.5*–95	30–*144.5*–164	122–*143.7*–173	102–*124.7*–150	15–*26.2*–30	70	70
			7–*9.2*–11	5–*6.0*–8	1–*1.5*–2	3–*4.3*–5		4–4.3–5	2	5	5
Type *L.somesii*	Bristol	6–7	250–800	?	100–110	80	80	100	50	100–120	110
			2.0–5.0	?	?	?	?	?	?	?	?
re–measured	Bristol	6–7	549–*686.4*–1053	220–*337.0*–520	55–*80.3*–141	62–*82.4*–108	70–*91.7*–112	47–*88.0*–109	23–*35.8*–45	79–*117.3*–137	up to 140
			3–*5.6*–11	3–*5.2*–8	1–*1.6*–3	4–*4.4*–5	3.5–*4.5*–5	3.5–*4.7*–6	4	4–*6.5*–8	6.0–7.0
L. variabilis	Netherlands								?		
169	Den Helder	<2	200–330	100–175	56–*73.0*–96	54–*64.5*–75	65–*74*–83	100–110	40–60	absent	absent
			6	4	?	?	?	?	?		
167	Den Helder	<2	195–*246.*4–282	112–*154.8*–192	35–*45*–65	22–*82*–103	40–*104.3*–124	94–*98.7*–108	20–*35*–47	tetract	absent
			4–*4.8*–6	4–*4.5*–5	0.5–1	4	4	3.0–4.0	2.0–3.0		
4181	Zierikzee	<2	235–284	110–188	94	56–*75.5*–90	75–*103.8*–125	94–97	20–32	tetract	absent
			3.5–5	1.5–4	?	4	4	?	?		
3095	Yerseke	2	347–*359.3*–376	150–*184.3*–211	55–*86.6*–102	94–*96.4*–101	83–*102.0*–119	106–*120.0*–127	33–*37.0*–40	tetract	absent
			5	3.5–*3.8*–4	0.5–1.5	4	4	3.0–4.0	2 to 3		
3088	Strijenham	1	230–*248.7*–282	101–*138.6*–188	28–*60.2*–101	70–*79.8*–85	94–*98.0*–108	75–117	23–34	tetract	absent
			4	4	1.0–1.5	4	4	?	?		
4711	Grevelingen	0.5	249–*288.0*–319	75–*132.3*–206	ABSENT?	87–89	101–112	106–107	20	triact	present
			4	4		?	?	?	?		
3119	Yerseke	0.5	226–244	75–*133.8*–188	51–*72.7*–97	65–94	98–112	100–101	28	tetract	absent
			4	4	1.5–2	?	?	?	?		
4233	Wemeldinge	<2	190–239	145–155	47–*83.0*–108	97	117	115–117	30	triact	absent
			4	3 to 5	0.5–*1.3*–2	?	?	?	?		
4089	Wemeldinge	<2	235	141–*170.7*–188	45–*82.0*–126	80–91	94–117	82–94	32–33	triact	absent
			3.5	3–*3.5*–4	1–*1.3*–1.5	?	?	?	?		
3102	Zuid Beveland	<2	190–235	126	44–89	79	83	88–89	32	triactine	absent
			4	4	0.5–1.5	?	?	?	?		
4191	Schelphoek	<2	286–304	169–188	94–103	98–*103.0*–108	108–*131.5*–151	86–126	20–47	tetract	absent
			5	2.0–5.0	1.0–2.0	?	?	?	1.0–1.5		
311	Huisduinen	<2	330	155	40–70	74–75	103	138–139	45	absent	absent
			5	3	1	?	?	?	?		
4197	Zierikzee	<2	287	83–179	25–*57.3*–91	79–92	97–108	82–83	32	triact	absent
			5	3 to 4	0.5–1	?	?		?		
Van Koolwijk, 1982	Netherlands		80–320	70–110	70–110	50–120	?	50–120	10–25–40	30–70	absent
	combined		2–*5.5*–9	2–3.0–4	?	7	?	7	7	5–*7.5*–10	

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L. variabilis	Europe									
17867 (3 spec.)	Helgoland	6	220–330	65–150	60–150	90–*98.6*–106	101–*123.2*–143	100	40–50	tetract	absent
			5	4	0.5	?	?	4–*4.5*–5	?		
17932	Belgium, Zeebrugge	<2	244–*340.9*–475	125–*171.3*–230	75–*88.0*–95	92	103	30–*78.5*–110	10–*26.5*–40	triact	absent
			4–*5.6*–9	1–*3.5*–6	1	2–*2.75*–3	?	3–*4.0*–5	2		
9708	France, Ambleteuse	<2	235–253	126–154	54–*90.7*–126	52–*69.9*–85	65–*85.3*–108	94	28–39	absent	absent
			1–6	4	1–*1.3*–1.5	4	3	?	?		
9689	France, Audresselles	<2	214–*256.0*–296	120–*151.0*–182	50–94	50–*73.2*–83	75–*92.8*–108	101–103	20–40	absent	absent
			4–*4.7*–5	2.0–4.0	1.0– 2.0	?	?	?	?		
2703	France, Wimereux	<2	214–238	141	61–*82.7*–108	83–87	117–126	115–116	30	tetract	absent
			5.0–6.0	6	?	?	5	4	2		
171	Norway	0.5	255–*341.0*–428	97–*131.0*–169	28–*61.6*–94	108–*128.6*–149	94–*126.1*–149	117	28–47	tri–,tetract	absent
			10–*10.8*–12	3–*5.3*–7	0.5–*0.7*–1	8.0–9.0	8 to 9	8	5		
4974	Norway, Hjeltefjord	<2	326–352	101–*183.8*–235	63–139	94–126	134–149	107–108	32	absent	absent
			4.5–5.0	4.0–5.0	1.5–2	4	4.0–5.0	4	3		
16318	Ireland, Sherkin	<2	305–*382.7*–447	164–228	61–*86.6*–122	103–*125.0*–141	94–*121.0*–141	108–135	18–47	tri–,tetract	absent
			3.5–5	3.5–6	0.5–*1.3*–2	3.5–6	3.5–6	6 to 7	?		
10889	Ireland, Cahirsiveen	0.5	258–*367.3*–463	108–179	75–92	87–*101.0*–108	79–*94.8*–112	122	56	tetract	absent
			3–*4.2*–5	2.5–3	2	?	?	4			
5218	N Spain, La Toja	<2	390–520	142–*197.3*–248	56–*65.0*–81	79–*97.3*–108	83–*91.5*–94	97–108	32–47	tetract	absent
			6.0–7.0	4.5–4.5	2 to 3	5	4	4	3		
Topsent, 1936	France, Luc, Concarneau		285–500	65–110?	65–110?	65–135	?	85–115	30–50	absent	absent
			6.0–10	?	?	8	?	6	?		
Sarà, 1953	France, Roscoff		420	?	42?	28–140	?	21–133	21?	?	absent
			1.0–13	?	1?	4 to 14	?	5.0–14	?		
Arndt, 1935	NW Europe	2	80–320	70–110	?	65–100	?	65–100	?	triact	absent
			2.0–10	2.0–10	?	7.0–8.0	?	7.0–8.0	?		
Haeckel, 1872	Norway	2–3	100–300	100–300	70–90	120	110	120	80	?	absent
			7.0–10	7.0–10	2.0–5.0	8.0–9.0	?	8.0–9.0	4 to 5		
Minchin, 1905	Roscoff, Plymouth	1.5–2	80–400	70–200	?	80–120	65–83	65–83	moderate – large	triact	absent
			2.0–9.0	7.0–10	?	7.0–8.0	?	7.0–8.0	?		

?, missing data.

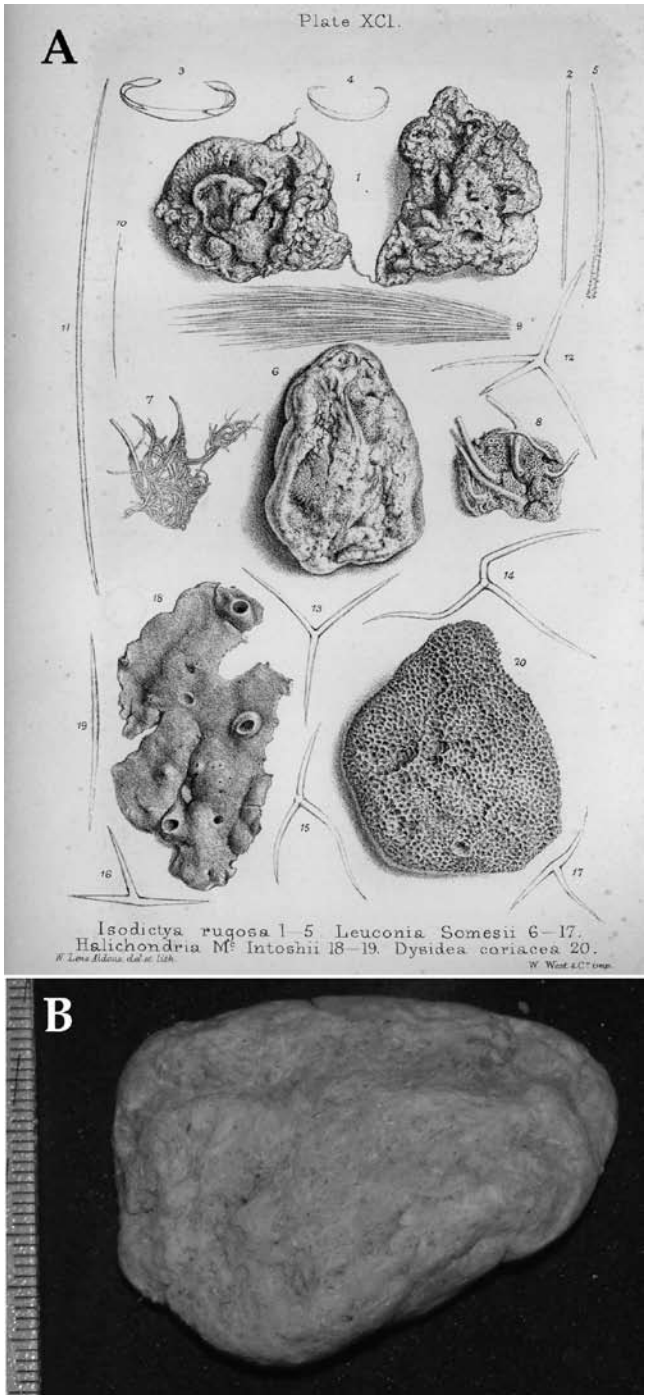

Figure 4. Bowerbank's (1874) plate of *Leuconia somesii* (figure 6–17).

Description

Shape, size, surface, colour and consistency: mass of anastomosed tubes, in preserved condition at least 12×12×8 cm, but alive it was considerably more expanded (Figure 1H). Colour was off-white and the consistency fragile. Oscular tubes at least 8 mm in diameter, closed tubes may be as thin as 1 mm or less. Tubes increasingly branching towards the periphery of the body, at right or sharp angles, but with few or no diverticula. The Neeltje Jans specimen was much smaller, similar in shape and size to a typical *L. variabilis*, but sharing the spicular characters of the large Colijnsplaat specimen (see below).

Skeleton: tube wall consists of a layer of triactines and tetractines supported by larger and smaller oxeas. Triactines are arranged rather irregular, with rays of the regular ones tangential to the surface. Apical rays of tetractines and unpaired rays of irregular T-shaped triactines protrude into the tubar cavity. Large oxeas and intermediate oxeas both tangentially and at sharp or right angles to the surface. The latter make the surface hispid to varying extents. Small oxeas mostly arranged perpendicular to the surface.

Spicules (Figure 3C), based on combined observations from both specimens: (a) triactines, large, relatively thin, with many aberrant T- and V-shapes, paired rays on average longer than unpaired ray, but both longer and shorter occur. Size: paired rays 23–144.0–188 × 2–4.6–7 μm, unpaired rays 103–123.0–155, 2–4.5–6 μm; (b) tetractines, likewise relatively large and thin, paired rays and unpaired ray similar in length and thickness, 108–159.0–171 × 4–4.5–5 μm, apical ray 20–26.6–32 × 2–3.1–4 μm; (c) large oxeas, smooth, irregular outline and diameter, ends more or less pointed, not lance-shaped; long thin, more or less straight oxeotes found in moderate quantities are considered young growth stages. Size: 450–553.2–672 × 7–9.1–11 μm; (d) intermediate oxeas, smooth, irregular in outline and diameter, ends more or less pointed like large oxeas, not lance-shaped at one of the ends. Size: 165–271.9–360 × 5–6.0–8 μm; (e) small, straight, spined oxeas (invisible or barely visible by light microscopy). Size: 81–90.8–96 × 1–1.5–2 μm.

Remarks

Bowerbank's *Leuconia somesii* (Figure 4A,B) was assigned to *Leucosolenia variabilis* by Minchin (1905) largely on the basis of spicule characters, whereby its extreme size and shape was ignored. The species *L. somesii* was subsequently ignored in the literature, but its name is here revived on the basis of a comparison of its characters with a large number of *L. variabilis* specimens from the Netherlands and adjacent countries. The type of *L. somesii* (BMNH 1925.11.2.24; Figure 4A,B) shares most of its features with ZMA 17572, and concerning the spiculation, with ZMA 11389. The large body size and compact shape, the large oxeas, and the high frequency and diversity of shapes of malformed tri- and tetractines, including V-shaped spicules (see Figure 4A and Table 1 for details, and compare with Figure 3C). The type of *Leuconia somesii* and the Dutch specimens 17572 and 11389, however, also share features of shape and spiculation with *Leucosolenia variabilis*. An extensive comparison was made with *Leucosolenia variabilis* specimens in the ZMA collection (see also Table 1).

Scanning electron microscopy images of the smallest oxeas of ZMA 17572 and 11389 (Figure 3C, right hand corner) revealed extensive spines and at first this was considered evidence of specific distinctness. However, SEM images subsequently made of Dutch and other western European *Leucosolenia variabilis* specimens demonstrated that this spination is a common, though up till now undetected feature of *L. variabilis* individuals. It shows that SEM studies of Calcarea are necessary to reveal microstructures of the spicules. Excepting ZMA Por. 17572 and 11389, the Dutch specimens in the ZMA collection were assigned on the basis of descriptions of Haeckel (1872), Minchin (1905), Arndt

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(1935) and Topsent (1936) to *Leucosolenia variabilis*, by van Koolwijk (1982) and subsequent unpublished specimens by van Soest c.s. They have fairly uniform morphological and spicular characters (see Table 1). Based on examination of 13 specimens spread across the coasts of the Netherlands, the following ranges of spicule measurements were found: triactines have paired rays 56–87.1–108 μm, usually smaller than the unpaired rays, which measure 75–104.2–151 μm. Tetractine paired rays 75–103.2–139 μm, apical rays 20–47 μm. Large oxeas 190–270.1–376 × 3.5–6 μm, intermediate oxeas usually strongly overlapping with large oxeas, 75–211 × 3–6 μm, small (spined) oxeas 35–126 × 0.5–2 μm. Malformations are unusual, but T-shaped triactines and tetractines occur occasionally.

Compared with the above described specimens ZMA Por. 11389 and 17572, and also the type of *L. somesii*, the large oxeas of typical Dutch *L. variabilis* are distinctly and significantly smaller and thinner and usually have lance-shaped endings at one or both ends, the intermediate oxea size-category is indistinct and overlapping with the larger oxeas. No V-shaped large malformed triactines were found. In other locations in Europe, oxeas of up to 520 μm are found in exceptional cases (ZMA Por. 05218 from northern Spain), and Topsent (1936) also gives 500 μm as an upper size in a specimen from Concarneau (Bretagne), but these values are extremes and the average size is much lower. Large oxea sizes in most of the other locations outside the Netherlands are mostly larger, but do not reach the average size of ZMA 11389, 17572 and the type of *L. somesii* (see Table 1: average Belgium: 332 μm; France: 244 μm; Spain: 455 μm; Ireland: 377 μm; Germany: 267 μm; Norway: 340 μm).

Less significant, but noticeable are the average smaller size of tetractines and triactines, of which the paired rays are usually shorter than the unpaired rays, whereas specimens 11389 and 17572 show the opposite. There is a discrepancy with the type of *L. somesii* in this feature, as this has triactine and tetractine sizes similar to the majority of *L. variabilis* specimens and dissimilar to ZMA 11389 and 17572. The significance of these differences remains to be further established, as Minchin (1905), based on specimens from England and France, maintained that the unpaired rays of the triactines of *L. variabilis* are always shorter than the paired rays (and he used that to distinguish *L. variabilis* from *L. complicata* where the unpaired rays are always longer). Topsent (1936) commented that in most of his (French) specimens of *L. variabilis* the unpaired rays of the triactines were longer instead of shorter. In ZMA specimens of Belgium, France, Ireland and Norway, the unpaired rays were observed to be variably longer or shorter than the paired rays, rendering the value of this distinction rather dubious.

The taxonomy of European *Leucosolenia* species shows a chequered history of distinction of many different forms (e.g. Haeckel (1872) recognized ten species and varieties), extensive synonymization (e.g. Burton (1963) recognizing only a single species), and recognition of reinstated species. The four currently recognized species (van Soest et al., 2000) differ in habit and partially in spicule size and shape. The shape of the sponges is characteristic and constitutes the main diagnostic character: *L. complicata* has individual ascon tubes densely provided with diverticula; *L. botryoides* has ascon tubes short, terminally swollen and arranged in a dense bunch, always attached to seaweeds; and *L. fragilis* has the individual ascon tubes singly erect on the stolon network on the substrate. *Leucosolenia variabilis*, in contrast, has ascon tubes relatively long and undivided. The spicule composition of these *Leucosolenia* species is largely similar. All have triactines with rays 50–200 μm, similar-sized tetractines, large oxeas sometimes divisible into two overlapping sizes, and small thin oxeas (probably spined, although this has not been documented). The proportional abundance of triactines, tetractines and oxeas varies apparently within the recognized species, but was reason for Haeckel and others to distinguish further species or varieties, e.g. *L. fabricii*, *L. confervicola*, *L. corallorhiza*, *L. himantia*, *L. tenuis* and *L. thamnoides*. For Sarà (1956) it was reason to suggest they were hybridizing.

The material represented by ZMA Por. 11389 and 11752 falls within the variation of shapes found in *Leucosolenia variabilis*, as the ascon tubes are relatively undivided and do not possess dense diverticles. The size of ZMA Por. 17572 is exceptional, as Dutch *L. variabilis* usually do not exceed 2 cm. However, several specimens recently collected at Helgoland (ZMA Por. 17867) were more than 6 cm in length, but conformed to the average *L. variabilis* in spicular characteristics, so the great size in itself is not distinctive, even though unusual. Possibly, the large size indicates these specimens were imported, as larger sizes are commonly observed in introduced species, e.g. the nudibranch *Geitodoris planata*, reaching a size of 12 cm in the Oosterschelde shortly after its introduction (P. v. B., personal observation).

The above noted differences of the two new Dutch specimens and the type of *L. somesii* with typical Dutch *L. variabilis* appear too large to simply consider them infraspecific variation. We propose to revive *Leuconia somesii* Bowerbank, 1874 as a valid species in the genus *Leucosolenia* with the large body size, the larger oxeas, and the high frequency of V-, T-shaped and other malformed triactines and tetractines as unique features. Bowerbank received his material from the Bristol Aquarium where it was found growing on the brick walls, which is a curious coincidence with the location of ZMA 17527, which was found growing in the incurrent seawater pipe of a laboratory.

SPONGES FROM INLAND WATERS

The three records presented below presumably represent specimens of common Dutch sponges showing abnormal morphological and spicular features, which are likely caused by their occurrence in land-locked water bodies.

Hymeniacidon cf. *perlevis* (Montagu, 1818)
Figures 1I & 5A (SEM images)

Material examined

ZMA Por. 19877, Netherlands, Zeeland, Veerse Meer, Jonkvrouw Annapolder, 51.549°N 3.845°E, 07 September 2006, coll. M.J. de Kluijver, no. 1513-1, salinity 29.9‰, depth 1.7 m.

Studied for comparison: ZMA Por. 19878, Zeeland, Lake Grevelingen, Den Osse, 51.75°N 3.9°E, 10 September 2006, coll. M.J. de Kluijver, no. 1522, salinity 30.3‰, depth 2.6 m.

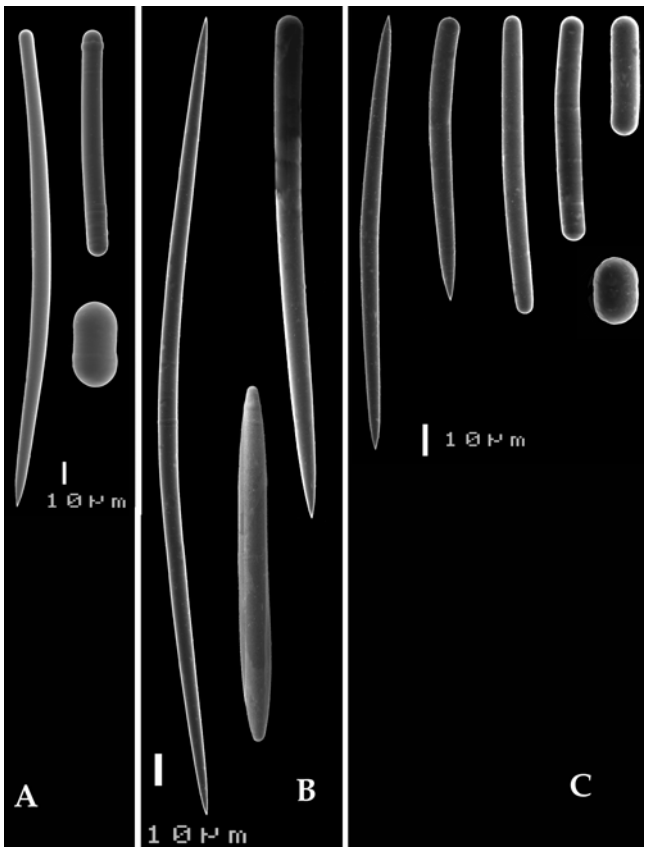

Figure 5. Scanning electron microscopy images of spicules of discussed specimens: (A) *Hymeniacidon perlevis*? from Veerse Meer; (B) *Halichondria* (*Halichondria*) *panicea* (?) from the Schelphoekplas; (C) *Haliclona* (*Soestella*) *xena* from the Schelphoekplas.

Description

Shape, size, surface, colour and consistency: thickly encrusting on a mussel shell, size 4×3×0.5 cm (Figure 1I). Surface has several depressions, but is otherwise more or less smooth, with faint stellar patterns of excurrent canals. No oscules are visible in the preserved specimen. Colour yellow-orange. Consistency firm.

Skeleton: a distinct peripheral skeleton of spicule brushes is present, covered with tangentially arranged spicules and intercrossing spicule bundles. The choanosomal skeleton is confused with vague vertical spicule tracts among a loose arrangement of single spicules.

Spicules (Figure 5A): styles in a large size-range, but not divisible in distinct size-classes, heads with faintly developed tyles, size: 192–224.0–249 × 5–6.8–8 µm. Rarely both ends are rounded to form strongyle-like spicules. Additional spicules are peculiar 'silica-bodies', elongate–spheroid in shape with a constricted middle part. Presumably these represent deformed and compressed stylo-strongyles, but they are two to three times as thick as the normal styles. A few intermediate spicule forms seem to confirm this assumption. Size of silica bodies 28–39.8–47 × 15–20.7–28 µm.

Remarks

The specimen is hesitatingly assigned to *Hymeniacidon perlevis*. The skeleton and the majority of the spicules fall within the variation described for this species, e.g. in van Soest et al., 2000. A comparison was made with a specimen collected from open water in a large marine water body, Lake Grevelingen near Den Osse. This showed similar skeletal characteristics, but length of the spicules shows the usual wide range of *H. perlevis*, with sizes 140–427 × 3–7 µm. In comparison, the present abnormal specimen has a much narrower size-range of styles and on average these are relatively thicker. The silica bodies have not been observed before in sponges from the Netherlands (but see below in *Haliclona* (*Soestella*) cf. *xena*), nor from any nearby country. However, the ZMA collection holds specimens of *Tethya irregularis* Sarà & Bavestrello, 1998 from Lanzarote (ZMA Por. 07704, coll. J.H. Stock) possessing very similar silica bodies (cf. Sarà & Bavestrello, 1998: figure 1b). The specimen was collected in an inland cave-like habitat some distance away from the sea. Specimens of *Tethya omanensis* Sarà & Bavestrello, 1995 (ZMA 17482, Oman, Muscat, coll. R. Moolenbeek c.s., 2002) from a similar cave-like habitat also show a high proportion of spheroid and ovoid silica bodies among the normal spicules. Uriz et al. (2003) provide images of 'hypersilicified' spicules of *Suberites tylobtusus* Lévi, 1958, *Guitarra* sp. and *Chondrilla nucula* Schmidt, 1862, which appear similar to the present spicular anomalies. Uriz et al. (2003) associate these spicule types with a high silica concentration of the ambient seawater. Unfortunately, we do not have silica concentration data of our localities, so we cannot confirm this.

Halichondria (*Halichondria*) cf. *panicea* (Pallas, 1766)
Figures 1J & 5B

Material examined

ZMA Por. 19872, Netherlands, Zeeland, Schelphoekplas, depth 0.5–1 m, 51.7°N 3.636°E, November 2006, coll. R.Nijland; fragment taken from a much larger specimen photographed *in situ* in Figure 1J.

Description

Shape, size, surface, colour and consistency: massive specimen, of 70 cm diameter, consisting of coalesced digitations separated by depressions filled with sediment and algae. Specimens *in situ* look quite peculiar and distinct (Figure 1J), unlike any of the recorded Dutch sponge species. Several larger apertures occur in low frequency over the body, possibly representing oscules.

Skeleton: conforming to commonplace *H.* (*H.*) *panicea* specimens, cf. Vethaak et al. (1982). Malformed spicules are mingled among the normal spicules.

Spicules (Figure 5B): divisible into normal oxeas and stylote modifications. The oxeas are curved, gradually pointed, possibly in two overlapping size-categories as is usual for the species, sizes 249–282.3–325 × 5–8.0–11 µm. The second type of spicule would merit the name styles if their malformed condition would not be taken into account. There are no intermediate spicules apparent. The stylote modifications are shorter and relatively fatter than the oxeas, with the rounded end usually thickest and often faintly tylote, sizes 182–194.8–221 × 7–8.7–10 µm.

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Table 2. *Annotated checklist of sponges reported from the Netherlands. The order follows Hooper & van Soest (2002). Included are all species recorded living within the 12 mile zone, notably the Oosterschelde sea arm and the marine Lake Grevelingen, and from the Texel–Den Helder area in the Wadden Sea in the north. Excluded are species recorded from the Dutch Continental Zone outside the 12 mile zone and beached specimens.*

Demospongiae

Homosclerophorida, Plakinidae

Oscarella lobularis (Schmidt, 1862)

Recorded twice (2006) from the same locality in the Oosterschelde. Elsewhere common along the coast of Britain, Ireland and France, southward into the Mediterranean.

Hadromerida, Clionaidae

Cliona celata Grant, 1826

Common in all inshore waters, both in the south-west and in the Wadden Sea. Supposedly cosmopolitan.

Suberitidae

Protosuberites denhartogi van Soest & de Kluijver, 2003

Common in the south-west of the Netherlands (previously *Prosuberites epiphytum*, but recently renamed). Recorded from the coasts of Britain, Ireland and France.

Suberites massa (Lieberkühn, 1859)

Recorded twice, but observed (PvB) to be quite common recently.

Suberites aff. *virgultosus* (Johnston, 1842)

Until this publication only known from the Dutch part of the continental platform, now—if correctly assigned—also known from Oosterschelde.

Poecilosclerida, Myxillina, Coelosphaeridae

Celtodoryx girardae Perez et al., 2006

Recorded twice in consecutive years 2005 and 2006 from the same locality, Wemeldinge. Also observed south of Tholen and in the Roompot (P. v. B.). Elsewhere, described from the Bay of Morbihan, Bretagne, France. Further distribution not known.

Mycalina, Esperiopsidae

Amphilectus lobatus (Montagu, 1818)

Single occurrence, 1984: Texel, dike near the Netherlands Institute of Sea Research.

Mycalidae

Mycale (Carmia) micracanthoxea Buizer & van Soest, 1977

Undated RMNH material was identified as *Mycale contareni* by Vosmaer, presumably collected around 1880 in the Oosterschelde area. Subsequently described as a new species by Buizer & van Soest, based on specimens collected in 1975 in the Oosterschelde area. Common in south-west Netherlands. Recorded from Spain by Carballo & García-Gómez, 1994.

Halichondrida, Halichondriidae

Halichondria (Halichondria) bowerbanki Burton, 1930

Common in all inshore waters, both in the south-west and in the Wadden Sea.

Halichondria (Halichondria) panicea (Pallas, 1766)

Common in all inshore waters, both in the south-west and in the Wadden Sea.

Hymeniacidon perlevis (Montagu, 1818)

Common in south-west Netherlands. First records from 1951.

Haploslcerida, Haplosclerina, Chalinidae

Chalinula loosanoffi (Hartman, 1958)

Approximately 20 records from 1975 till present, from the Oosterschelde and Grevelingen.

Haliclona (Haliclona) oculata (Pallas, 1766)

Common in all inshore waters, both in the south-west and in the Wadden Sea.

Haliclona (Haliclona) simulans (Montagu, 1818)

Recorded once (2001), from the Oosterschelde.

Haliclona (Haliclona) urceolus (Rathke & Vahl in Müller, 1806)

Recorded four times (1985–1996), from Oosterschelde and Lake Grevelingen.

Haliclona (Reniera) cinerea (Grant, 1826)

Recorded at least three times, 1951, 1979 and 2005, all from the Oosterschelde.

Haliclona (Rhizoniera) rosea (Bowerbank, 1866)

Recorded four times, from 1951 onwards, from the Oosterschelde and Lake Grevelingen.

Haliclona (Soestella) xena de Weerdt, 1986

First recorded in 1977, now common in all inshore waters, both in the south-west and in the Wadden Sea. Elsewhere reported from Le Havre, north-west coast of France (Breton et al., 1996) and Helgoland (M. d K., personal observation)

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Table 2. *(Continued.)*

Halisarcida, Halisarcidae
Halisarca aff. *dujardini* (Johnston, 1842)
Recorded twice in consecutive years 2005 and 2006, from three Oosterschelde localities, including Roompot and Sas van Goes.

Calcarea
Calcinea, Clathrinida, Clathrinidae
Clathrina coriacea (Montagu, 1818)
Recorded three times, twice from the Oosterschelde, once from Texel.

Calcaronea, Leucosolenida, Leucosoleniidae
Leucosolenia variabilis (Haeckel, 1872)
Common in all inshore waters, both in the south-west and in the Wadden Sea.
Leucosolenia aff. *somesii* (Bowerbank, 1874)
Two specimens, both from the western entrance of the Oosterschelde.

Sycettidae
Sycon ciliatum (Fabricius, 1780)
Common in all inshore waters, both in the south-west and in the Wadden Sea.
Sycon scaldiense (van Koolwijk, 1982)
Newly described from the Oosterschelde area on the basis of material first recorded in 1975. Subsequently sparingly found in the same area.

Remarks

Schönberg & Barthel (1998) described some habit and spicule variation in Baltic populations of *Halichondria* (*H.*) *panicea*, reporting stylote modifications in small numbers, but in certain individuals up to 30% of the spicules may be malformed. Since the Baltic is an area with lower salinity and restricted exchange of reproductive stages with North Sea and Atlantic populations, the high proportion of stylote modifications may have a cause comparable with that of the Schelphoekplas specimens. The shape of the specimens is unprecedented in Dutch populations of *H.* (*H.*) *panicea*. It cannot be excluded that the specimens belong to *Halichondria* (*H.*) *bowerbanki* Burton, 1930, but the peculiar shape is likewise not known from Dutch populations of this species.

Haliclona (*Soestella*) *xena* de Weerdt, 1986
Figures 1K & 5C

Material examined

ZMA Por. 19873, Netherlands, Zeeland, Schelphoekplas, depth 3 m, 51.7°N 3.636°E, November 2006, coll. R. Nijland.

Description

Shape, size, surface and consistency: thick mass of tubes, 30 cm in diameter with tubes up to 4 cm high (Figure 1K), conforming to the description of de Weerdt (1986). Consistency soft. Other specimens take the shape of thickly encrusting masses with rare tubes and oscules flush with an irregular surface. Colour beige-brown, not purple as described by de Weerdt (1986).

Skeleton: conforming closely to de Weerdt's (1986) description of the type, with a rather confused reticulation of tracts of 2–3 spicules across, and with many loose spicules strewn in the interior. The deviating spicules are built into the tracts among normal ones.

Spicules (Figure 5C): on the basis of their shape at least five main types of spicules may be distinguished, but many intermediates occur, making it clear that they are basically all derivates of the normal spicules: (1) oxeas, predominantly normal, curved, sharply pointed, but rather commonly centrotylote and rarely blunt-ending at both ends, size 143–150.4–169 × 5–6.0–8 μm; (2) styles, usually thickest at the rounded end, common, size 80–108.2–126 × 5–5.6–6 μm; (3) tylostyles, looking much like 'halved' centrotylote oxeas, rare: size approximately 95×10 μm; (4) strongyles, usually relatively fat, in a large size range that eventually ends in type 5 (see below), often centrotylote, rarely with a terminal tyle, common, size 23–61.6–112 × 6–9.6–15 μm; (5) spheroids, either single or in attached pairs, smooth, rare, diameter 9–14.7–18 μm.

Remarks

In contrast with the *H.* (*H.*) *panicea* deviating spicules described above, there are many intermediates between the normal oxeas and the various malformations. The specimen has the spheroid spicules in common with the Veerse Meer *Hymeniacidon perlevis* described above. In view of the commonplace shape and conformity of skeleton and normal spicules with *H.* (*S.*) *xena*, it is likely that the specimens belong to this species.

SURVEY OF THE DUTCH SPONGE FAUNA

Table 2 lists the species that have been reported from the Netherlands so far, including an indication of their distribution elsewhere. The list numbers now 23 species, excluding six species technically observed from the Netherlands but known only from dry unattached beach specimens: *Raspailia* (*Raspailia*) *ramosa* (Montagu, 1818) (ZMA Por. 03130), *Phakellia ventilabrum* (Linnaeus, 1767) (ZMA Por. 04476), or from offshore sandbanks: *Amphilectus*

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Table 3. *Sponge invaders in Dutch inshore waters and first year of observation.*

Mycale (Carmia) micracanthoxea Buizer & van Soest, 1977	approximately 1880
Chalinula loosanoffi (Hartman, 1958)	1880
Haliclona (Reniera) cinerea (Grant, 1826)	1951
Haliclona (Rhizoniera) rosea (Bowerbank, 1866)	1951
Hymeniacidon perlevis (Montagu, 1818)	1956
Sycon scaldiense (van Koolwijk, 1982)	1977
Haliclona (Soestella) xena de Weerdt, 1987	1977
Haliclona (Haliclona) urceolus (Rathke & Vahl, in Müller, 1806)	1985
Suberites massa (Lieberkühn, 1859)	1989
Leucosolenia aff. *variabilis* (Haeckel, 1870)	1996
Haliclona (Haliclona) simulans (Johnston, 1842)	2001
Celtodoryx girardae Perez et al., 2006	2002
Oscarella lobularis (Schmidt, 1862)	2005
Suberites aff. *virgultosus* (Johnston, 1842)	2005
Halisarca aff. *dujardini* (Johnston, 1842)	2005

fucorum (Montagu, 1818) (ZMA Por. 05833), and from offshore North Sea wrecks (collected by G. van Moorsel): *Suberites suberia* (Montagu, 1818) (ZMA Por. 09726), *Mycale* (*Carmia*) *macilenta* (Bowerbank, 1866) (ZMA Por. 10746), and *Myxilla* (*Myxilla*) *rosacea* (Lieberkühn, 1859) (ZMA Por. 09735, 09736).

DISCUSSION

Reports of immigrating or invading sponge species are rare and anecdotal, but the subject receives increasing attention. The Global Invasive Species Database (www. issg. org) currently lists only a single sponge, *Mycale armata* Thiele, 1899, a tropical Indo-West Pacific sponge which recently was introduced to Hawaiian harbours and is extending its cover rapidly over man-made and natural substrates (see also Coles et al., 1999). The sponge *Halichondria* (*H.*) *bowerbanki* is reported as an immigrant of estuarine waters along the west coast of the United States (e.g. Cohen & Carlton, 1995). The area of origin is indicated as the east coast and the causal agent oyster imports. Both reports are the result of monitoring activities on a baseline of prior inventories. Duran et al. (2004) using indirect phylogeographic reconstruction conclude that the Mediterranean species *Crambe crambe* (Schmidt, 1862) recently invaded the Atlantic islands off the coast of Africa. Other reports are less convincing, e.g. the assumed invasion of the Caribbean species *Desmapsamma anchorata* (Carter, 1882) into Indonesia announced by Calcinai et al. (2004) ignores the fact that Indonesia harbours a very similar native sister species, *Desmapsamma vervoorti* van Soest, 1998, of which material is described from as far back as 1899. It is likely that the subtle differences of *D. anchorata* and *D. vervoorti* were overlooked by these authors. This example makes it clear that only regular monitoring of an area that has been inventoried thoroughly will reveal true invasions. Tropical high biodiversity areas are insufficiently known for well-founded conclusions.

The sponge specimens recorded and described above were all collected and photographed by generalist or volunteer biologists—members of the Biological Working Group of the Dutch SubAqua Union, supplemented by incidental observations of members of the 'Anemoon' Foundation—all of whom are dedicated to monitoring the faunal changes in Dutch coastal waters. Needless to say, these monitoring activities are extremely important as early warning of pending invasions of newcomers, including sponges. Table 3 lists the species that are assumed to have immigrated into Dutch waters in historical time with indication of year of first observation. It is obvious from this list that only a few sponges in the Netherlands can be considered really autochthonous. A major reason for this apparent susceptibility to immigrant and invading species is the fact that the habitats in the south-western Netherlands available for sessile organisms, the dikes and other artificial structures, are relatively recently built (dating back a few hundred years) and underwent several recent changes of size and materials. Aided by shell fish imports and elevated winter temperatures immigrant species are apparently greatly facilitated by these factors.

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